

Global Night-Time Lights for Observing Human Activity

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ABSTRACT – We present a concept for a small satellite mission to make systematic, global observations of night-time lights with spatial resolution suitable for discerning the extent, type and density of human settlements. The observations will also allow better understanding of fine scale fossil fuel CO₂ emission distribution. The NASA Earth Science Decadal Survey recommends more focus on direct observations of human influence on the Earth system. The most dramatic and compelling observations of human presence on the Earth are the night light observations taken by the Defence Meteorological System Program (DMSP) Operational Linescan System (OLS). Beyond delineating the footprint of human presence, night light data, when assembled and evaluated with complementary data sets, can determine the fine scale spatial distribution of global fossil fuel CO₂ emissions. Understanding fossil fuel carbon emissions is critical to understanding the entire carbon cycle, and especially the carbon exchange between terrestrial and oceanic systems.

Keywords: urban, human settlement, smallsat, CO₂ emissions

1. INTRODUCTION

The most dramatic and compelling observations of the human presence on the Earth from space are the night light observations taken by the DMSP Operational Linescan System. Even more striking are higher resolution, color images taken by Don Pettit and other astronauts from the International Space Station. Pettit has compiled a sequence of the night-time images into a movie entitled “Cities at Night, an Orbital Tour Around the World” (www.youtube.com/watch?v=eEiy4zepuVE), in

which Pettit describes the images of city lights as “...one of the most beautiful unintentional consequences of humanity.”

This paper presents a concept for a small satellite mission to obtain systematic, global observations from space of night-time lights on the surface of the Earth. The observations should be at a resolution capable of delineating the primary features of human settlement.

The cornerstone of NASA’s program in space and Earth science is the community guidance in setting scientific priorities and recommended observations. NASA obtains this guidance through the National Academy of Science, which provides the community consensus in scientific priorities in “Decadal Surveys”. The first NASA Decadal Survey for Earth Science was released in February, 2007 (NRC, 2007). In that report one of the recurring themes was the importance of obtaining direct observations of the impact of human activity on the Earth system. There have been no more direct observation from space of the imprint of human presence than that obtained from the DMSP night lights data. Almost everyone has seen the deep purple poster showing the global night-time lights compiled from OLS, Figure 1 (Elvidge, et al, 2001,

http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Night_Lights_Poster.html).

Elvidge and collaborators have demonstrated, through many studies, the variety of information that can be gleaned from the night lights data beyond mapping of cities: from identifying fires, oil field flares, to fishing fleets to understanding human energy consumption (Elvidge 1997, 2001, 2009, 2010).